

# Improving the Protein Value of Alfalfa-Based Diets



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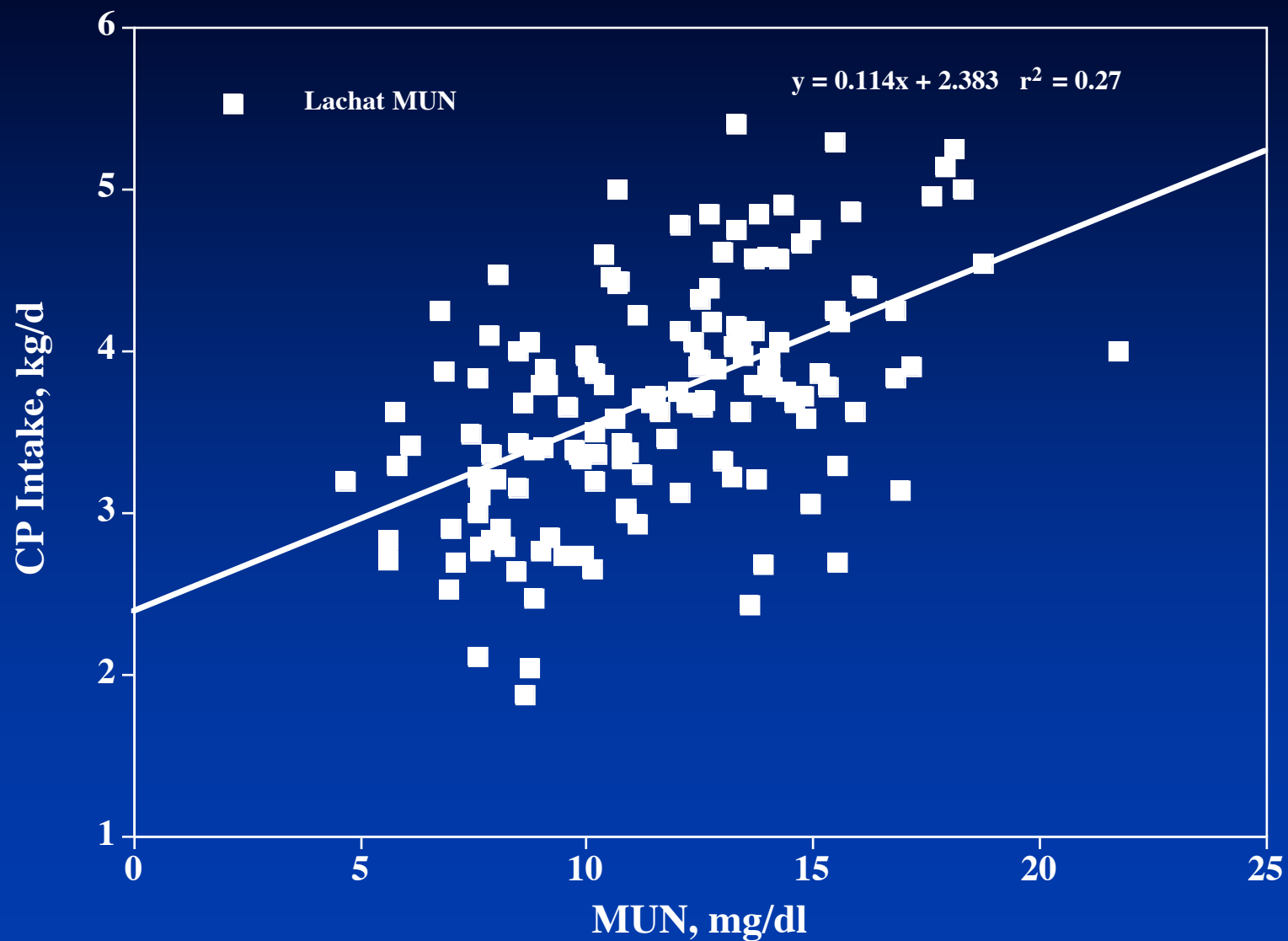
# Strategies to Improve Protein Utilization

1. Accurate Tracking of Dietary CP; Feed Less.
2. Reduce NPN in Hay-Crop Silage.
3. Feed Hay Rather Than Silage.
4. Dilute Hay-Crop Silage with Corn Silage.
5. Feed More Concentrate (as Much as Possible?).
6. Match Fermentable Energy & RDP.
7. Feed By-Pass Protein & Protected AA.
8. Use “N-Free” Essential AA (MHA?).

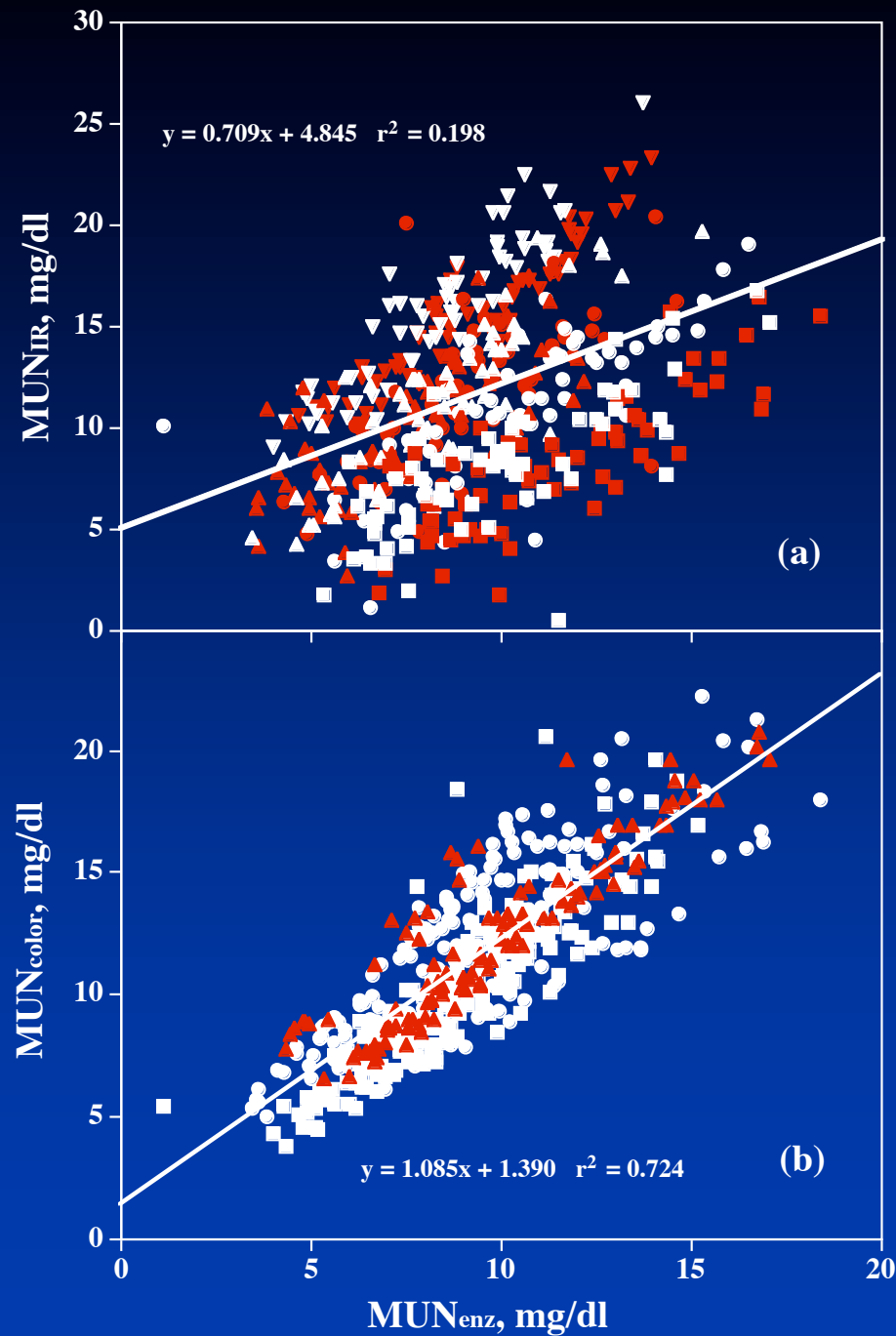
# Approaches to Improving Protein Utilization

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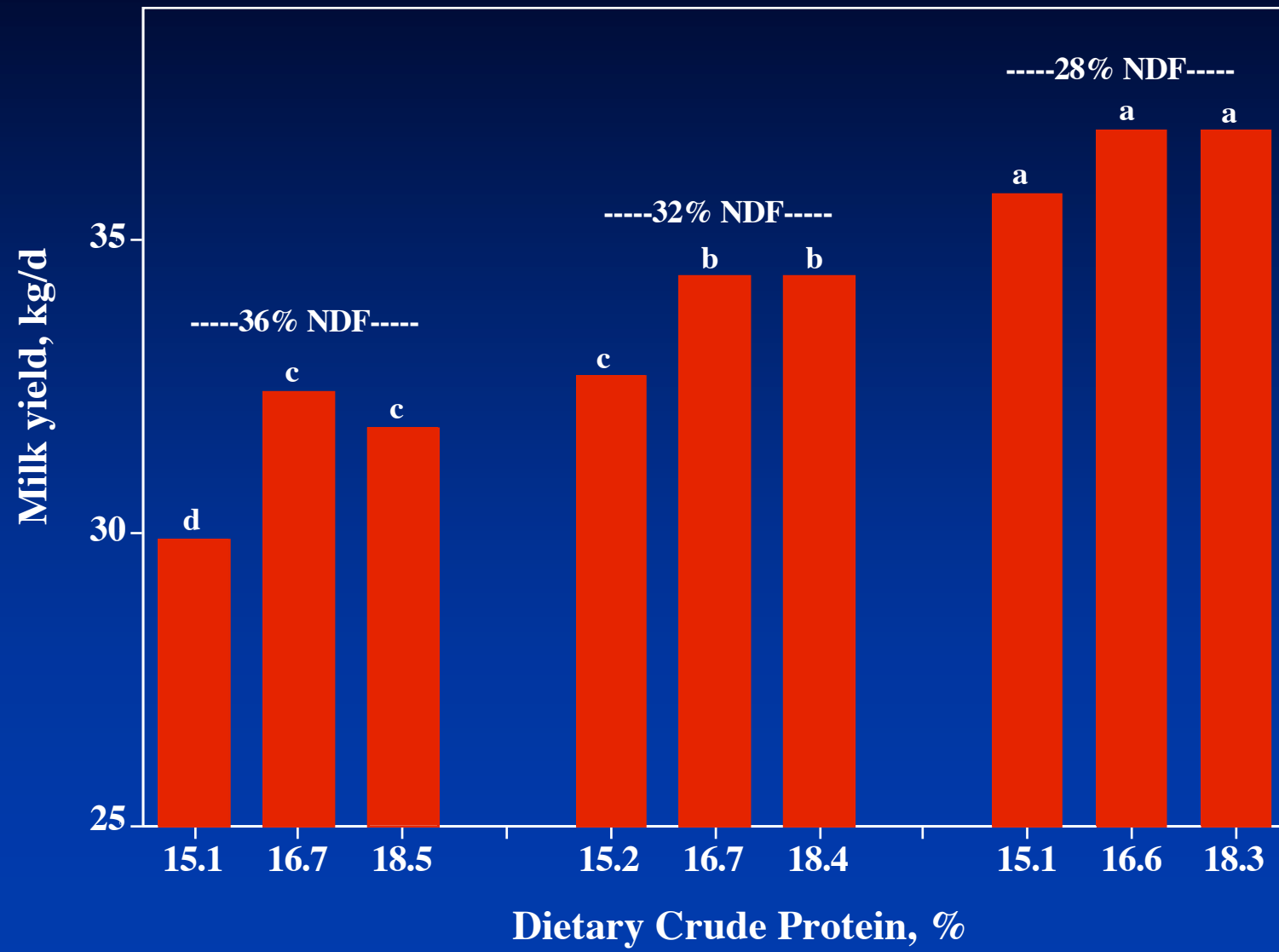
# Relationship of CP Intake & MUN (GAB53)



# Not All MUN Testing is Equal (GAB53)



# Effect of Diet on Milk Yield



# Approaches to Improving Protein Utilization

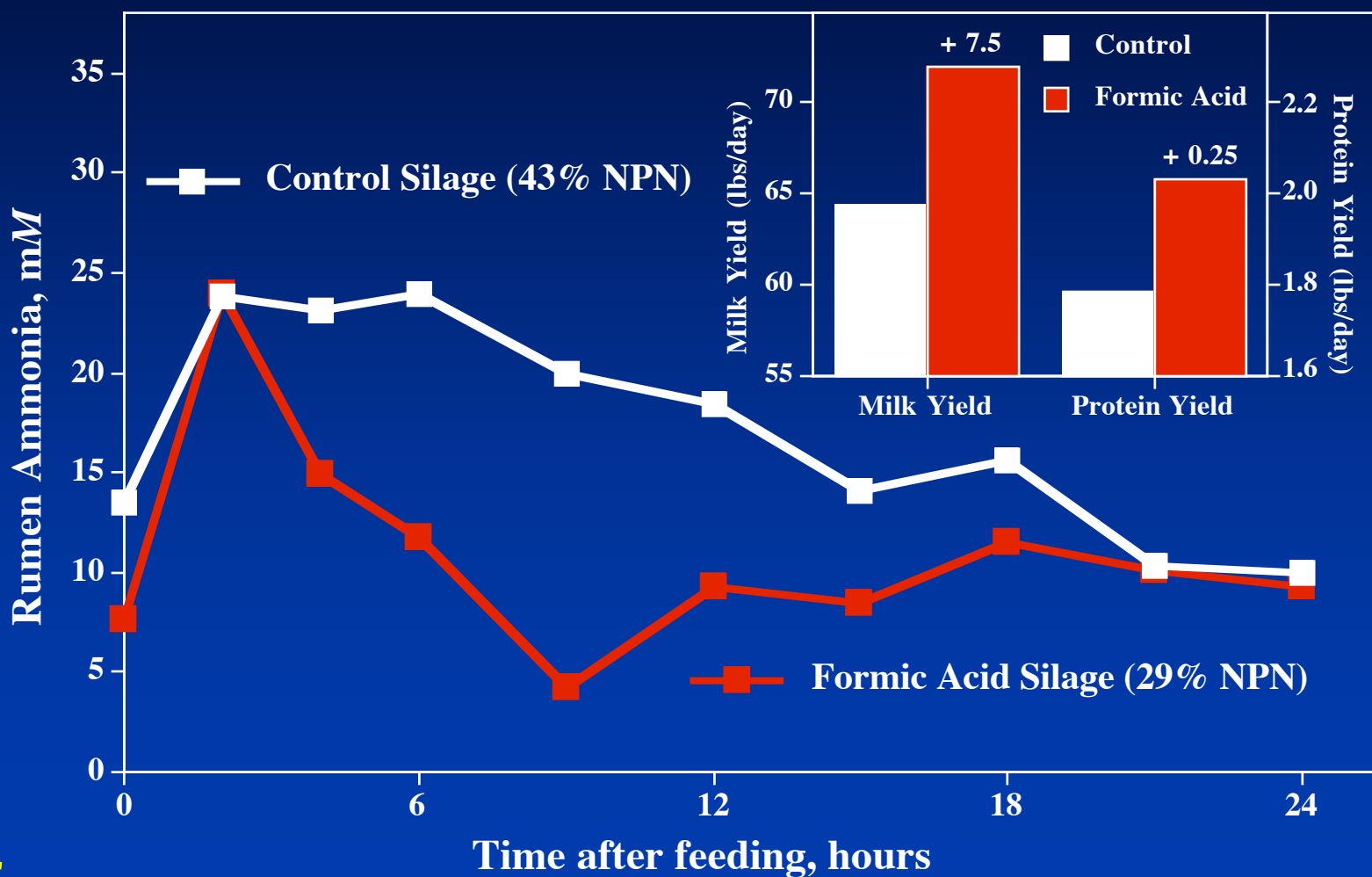
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# Composition of Alfalfa Silages from 43 Commercial Dairy Farms (Luchini et al., 1997)

| Item                     | Bunker      | O <sub>2</sub> -limiting | Tower       |
|--------------------------|-------------|--------------------------|-------------|
| Dry Matter, %            | 36.8        | 54.0                     | 49.6        |
| NDF, % of DM             | 45.8        | 41.5                     | 41.8        |
| Crude Protein, % of DM   | 19.4        | 20.7                     | 19.7        |
| ADIN, % of total N       | 9.7         | 6.7                      | 6.8         |
| <b>NPN, % of total N</b> | <b>62.3</b> | <b>55.4</b>              | <b>55.0</b> |



# Reducing NPN in Alfalfa Silage Decreases Rumen Ammonia & Improves Yield (Nagel & Broderick, 1992)



# Red Clover Feeding Studies



# Average Composition of Alfalfa & Red Clover Diets (5 Lactation Trials)

| Item                      | Silage Source |            |
|---------------------------|---------------|------------|
|                           | Alfalfa       | Red clover |
| <u>Silage Composition</u> |               |            |
| Crude protein, % of DM    | 21.2          | 17.9       |
| NPN, % of total CP        | 53            | 35         |
| <u>Diet</u>               | (% of DM)     |            |
| Alfalfa silage            | 60            | ...        |
| Red clover silage         | ...           | 60         |
| High moisture ear corn    | 36            | 36         |
| Soybean meal              | 3             | 3          |
| <u>Diet Composition</u>   |               |            |
| Crude protein             | 17.9          | 15.2       |
| NDF                       | 32            | 33         |

# Average Production on Alfalfa or Red Clover Silage (5 Lactation Trials)

| Item                      | Silage Source |             | Prob.            |
|---------------------------|---------------|-------------|------------------|
|                           | Alfalfa       | Red Clover  |                  |
| <b>Intake, lbs DM/d</b>   | <b>48.3</b>   | <b>45.6</b> | <b>&lt; 0.01</b> |
| Weight gain, lbs/d        | 0.04          | 0.42        | <u>0.08</u>      |
| Milk, lbs/d               | 70.3          | 69.0        | 0.37             |
| Fat, lbs/d                | 2.47          | 2.38        | <u>0.11</u>      |
| Protein, lbs/d            | 2.05          | 2.03        | 0.42             |
| <b>Milk N/N-Intake, %</b> | <b>24</b>     | <b>28</b>   | <b>&lt; 0.01</b> |
| DM digestibility, %       | 61.6          | 66.4        | < 0.01           |

## Red Clover Problems:

1. Lower Yields ~85-90% of Alfalfa.
2. Poorer Persistency (Dies out 1-2 years Sooner than Alfalfa).
3. Lower DM Intakes.
4. There May be a Milk Component Problem.

# Approaches to Improving Protein Utilization

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# Harvest Alfalfa as Hay or Silage?

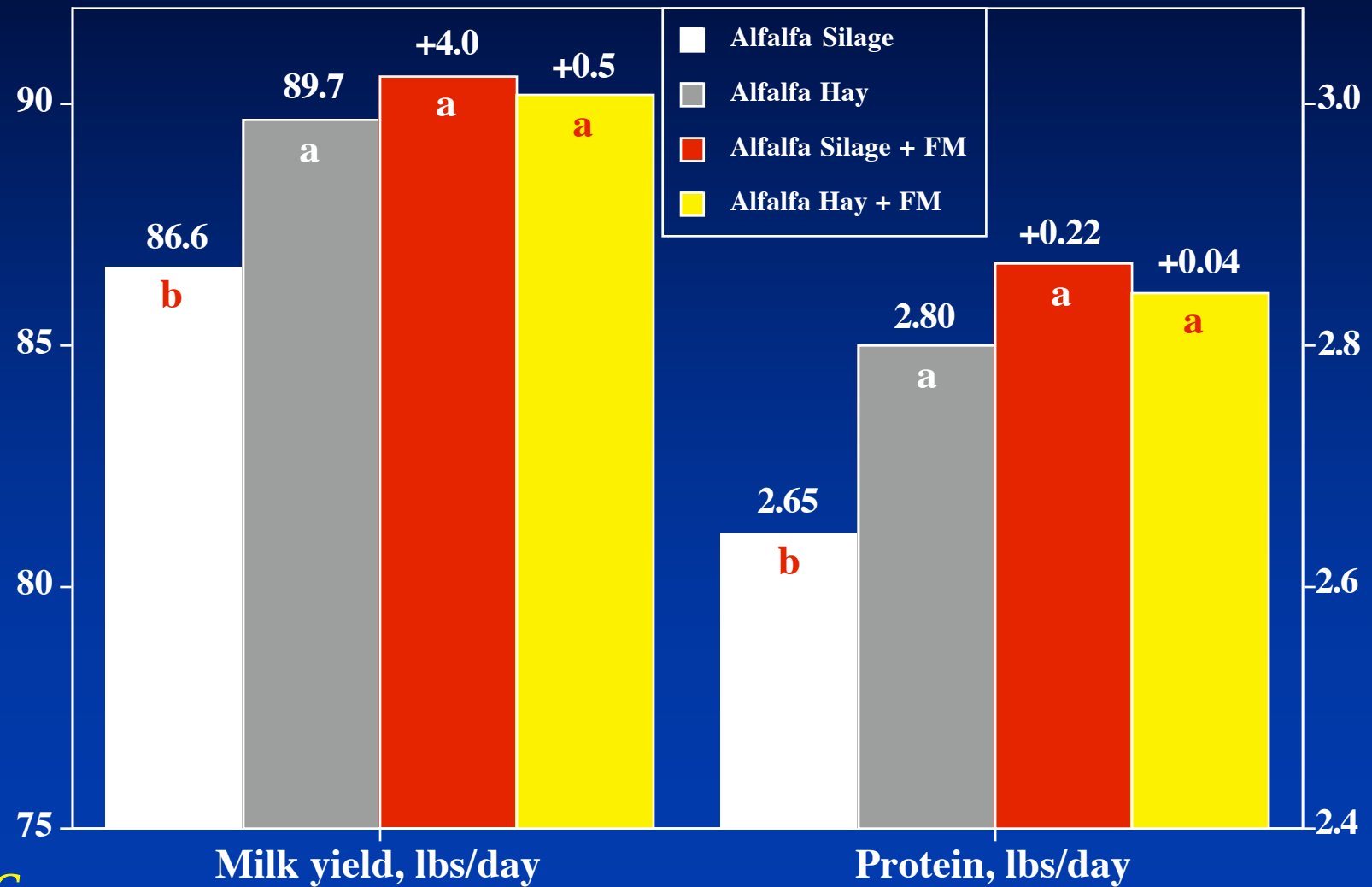


# Mean Composition of Alfalfa Silage & Hay

| Item             | Silage      | Hay        | Change, %  |
|------------------|-------------|------------|------------|
| DM, %            | 41          | 86         | N/A        |
| CP, % DM         | 20.6        | 18.1       | -12        |
| <b>NPN, % CP</b> | <b>51.9</b> | <b>8.0</b> | <b>-85</b> |
| NDF, % DM        | 38          | 38         | NS         |
| NEL, Mcal/kg DM  | 1.51        | 1.50       | NS         |
| Ash, % DM        | 10.4        | 9.8        | -6         |



# Fish Meal (FM) Supplementation of Diets with 50% Alfalfa Silage or Hay (Vagnoni & Broderick, 1997)



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## Replacing Alfalfa Silage with Corn Silage (Dhiman & Satter, 1998)

| Item                         | Forage Source       |                     |                      |
|------------------------------|---------------------|---------------------|----------------------|
|                              | AS                  | 2/3 AS:1/3 CS       | 1/3 AS:2/3 CS        |
| <u>Composition (% of DM)</u> |                     |                     |                      |
| Alfalfa Silage               | 50                  | 33                  | 17                   |
| Corn Silage                  | 0                   | 17                  | 33                   |
| Conc. Mix                    | 50                  | 50                  | 50                   |
| Crude Protein                | 18.6                | 17.5                | 16.6                 |
| <u>Production (kg/305 d)</u> |                     |                     |                      |
| Milk (Multiparous)           | 21,100 <sup>b</sup> | 22,400 <sup>a</sup> | 22,090 <sup>ab</sup> |
| Rumen NH <sub>3</sub> (mM)   | 12.3 <sup>a</sup>   | 10.5 <sup>b</sup>   | 9.4 <sup>c</sup>     |
| a,b,c ( $P < 0.05$ )         |                     |                     |                      |

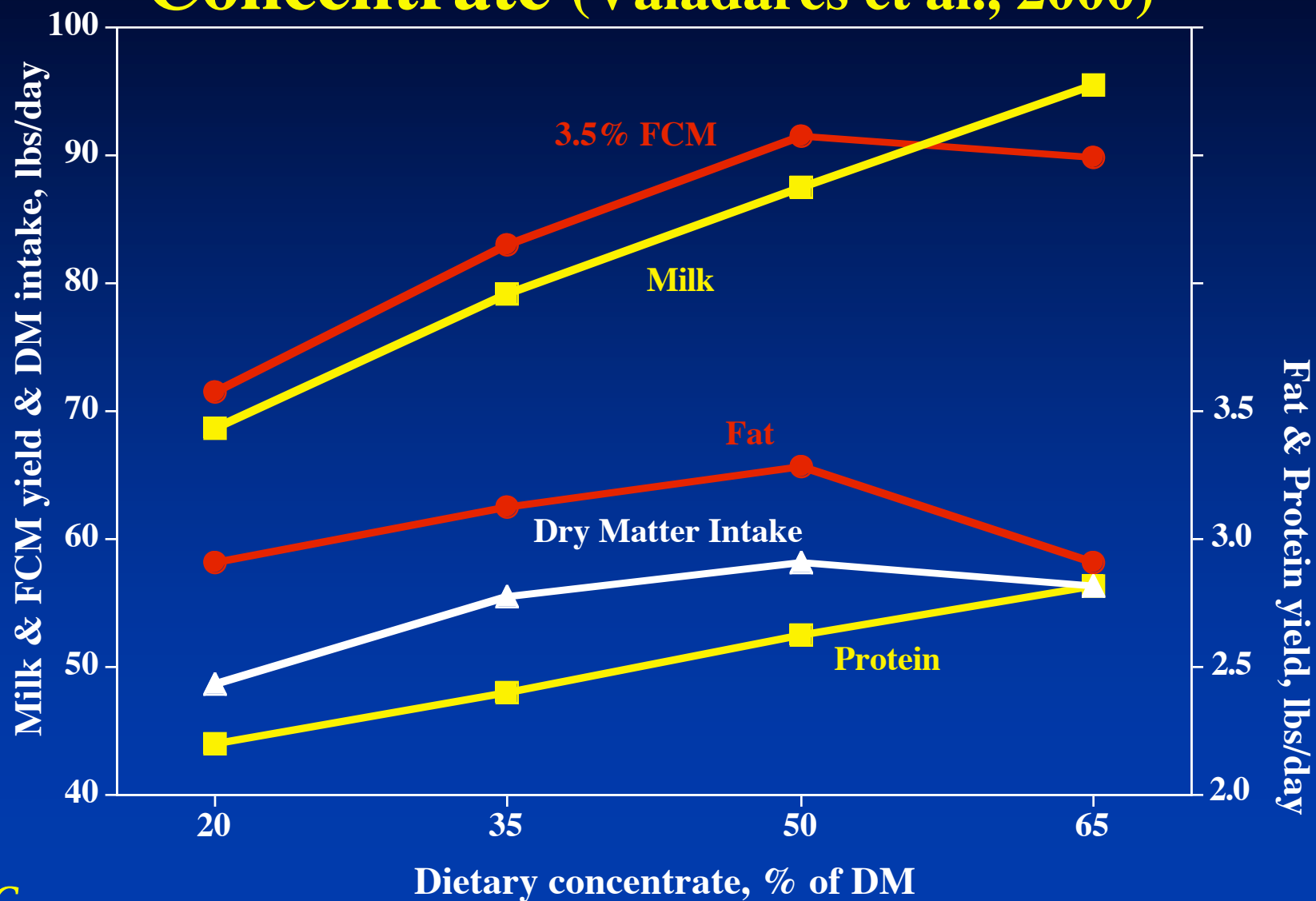
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# Even Norwegian Farmers say “Feed more Grain!”

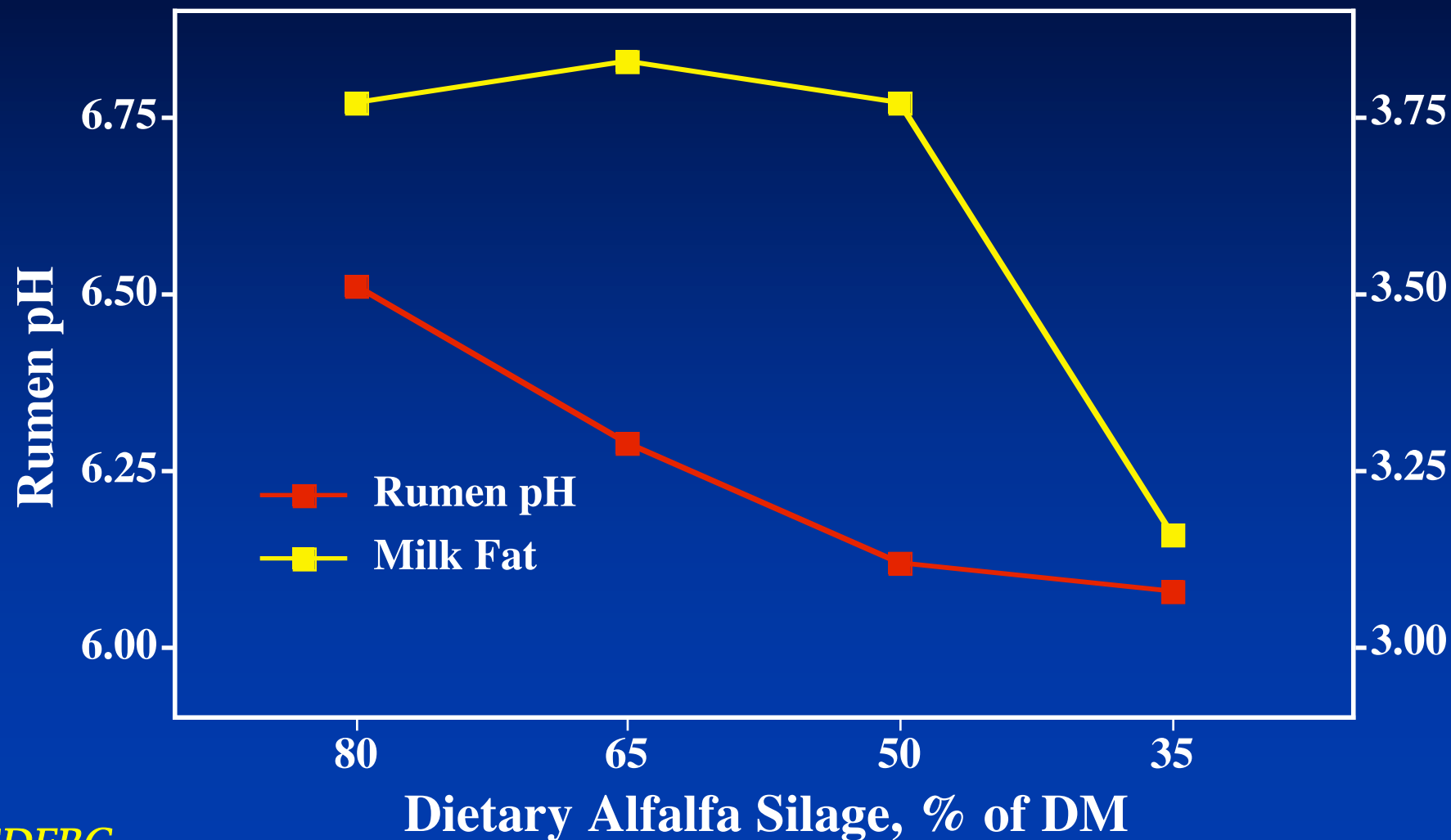


# Effect of Replacing Alfalfa Silage with Concentrate (Valadares et al., 2000)





# Forage Helps Maintain Rumen pH & Milk Fat



# Approaches to Improving Protein Utilization

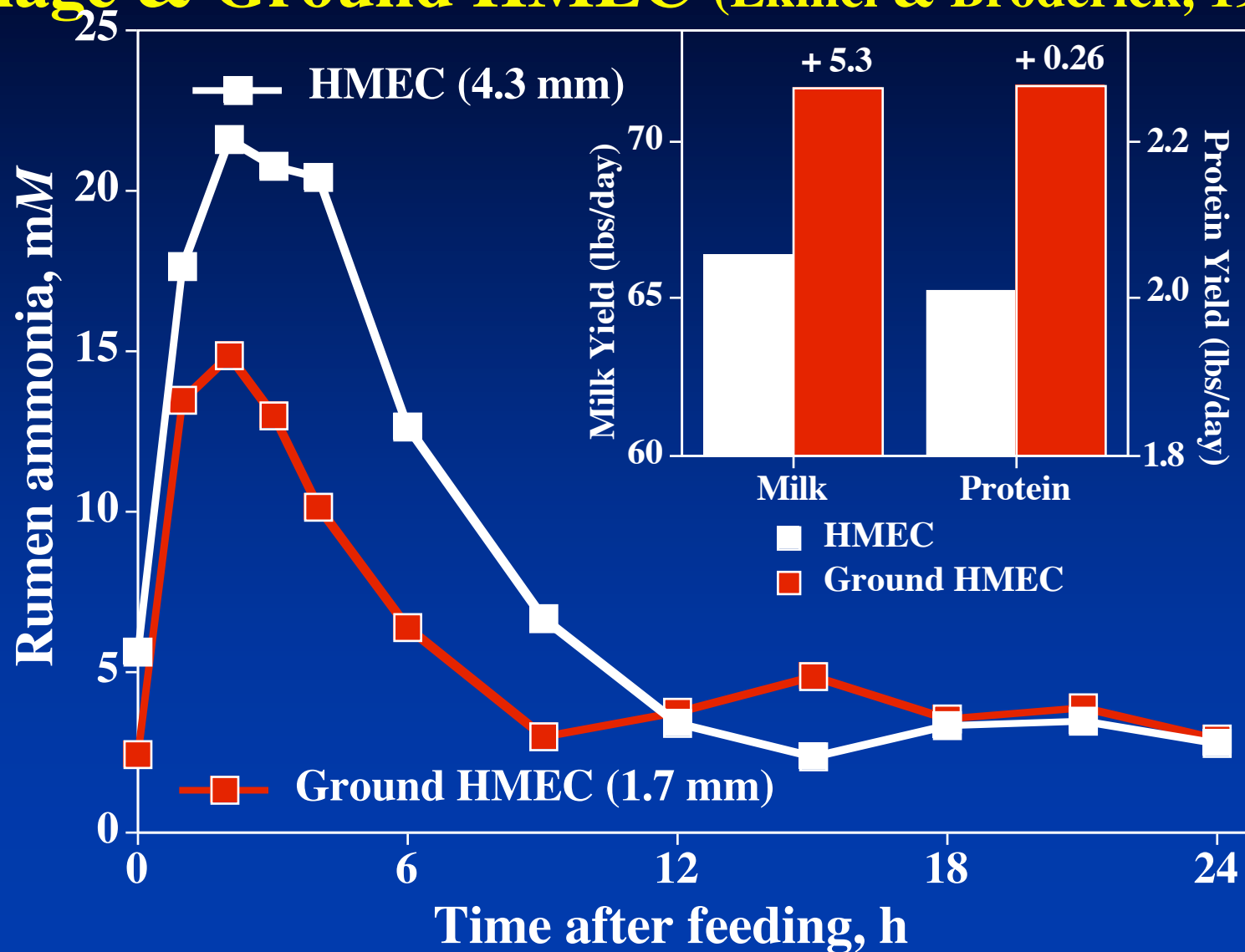
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# Effect of Processing on Digestibility of Corn & Barley Starch (Owens et al., 1986)

| Processing<br>Method | Proportion of Starch Digestion, % |                    |                    |                |
|----------------------|-----------------------------------|--------------------|--------------------|----------------|
|                      | Rumen                             | Small<br>Intestine | Large<br>Intestine | Total<br>tract |
| Cracked Corn         | 69                                | 13                 | 8                  | 89             |
| <u>Ground Corn</u>   | 78                                | 14                 | 4                  | 94             |
| Steam-Flaked Corn    | 83                                | 16                 | 1                  | 98             |
| High Moisture Corn   | 86                                | 6                  | 1                  | 95             |
| <u>Ground Barley</u> | 94                                | ...                | ...                | ...            |

# Rumen Ammonia & Production of Cows fed Alfalfa Silage & Ground HMEC (Ekinici & Broderick, 1997)



# Feeding Sugar as Energy

In 3 Trials, Similar Results were obtained by Replacing Corn Starch with:

Table Sugar

Dried Molasses

Liquid Molasses



# Feeding Sugar with Alfalfa Silage

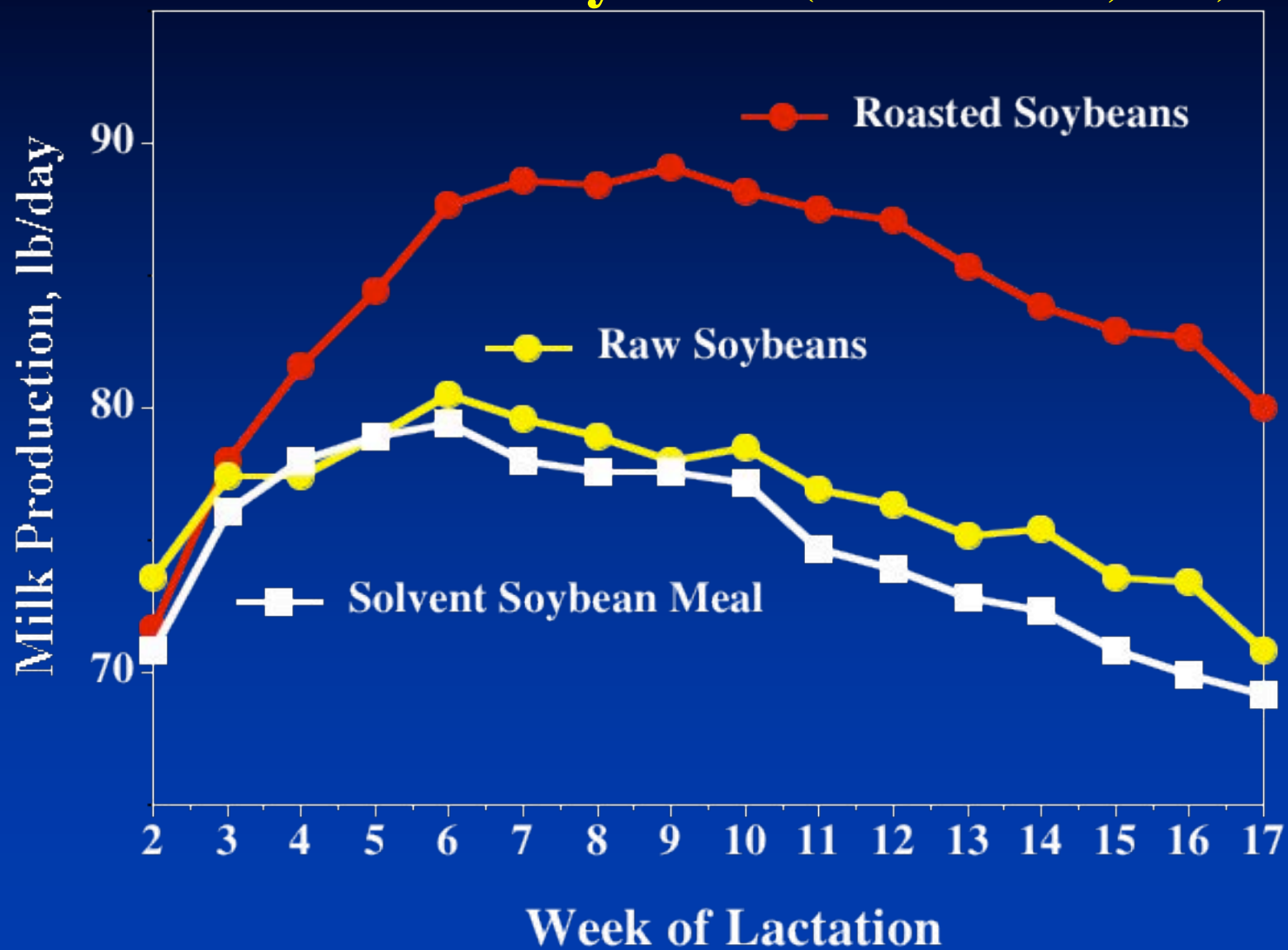
1. Replacing Dietary Starch with Sugar Increase Intake, OM Digestibility & Fat Yield.
2. Reduced Rumen Ammonia.
3. Small Effects on Milk & Protein Yield.



# Approaches to Reducing Dietary CP

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# Supplementation of a 50% Alfalfa Silage Diet with Raw or Roasted Soybeans (Faldet & Satter, 1991)



# Rumen In Vitro Bypass & Cow Response of Slowly Degraded Proteins in Cows Fed Alfalfa Silage

| Test Protein | Relative Response (Solvent SBM = 1) |                    |                        |
|--------------|-------------------------------------|--------------------|------------------------|
|              | In Vitro Bypass                     | Cow Response       | Rel. Response (trials) |
| Expeller SBM | 1.8                                 | Rumen Escape       | 1.6 (1)                |
|              |                                     | Protein Efficiency | 1.5 (3)                |
| Fish Meal    |                                     |                    |                        |
| Low-Bypass   | 1.7                                 | Protein Efficiency | 1.6 (1)                |
| High-Bypass  | 2.0                                 | Protein Efficiency | 2.1 (2)                |

# Variable Response with Rumen Protected Met + Lys

1. Piepenbrink et al. (1996): No Improvement in Milk & Protein Yield.
2. Armentano et al. (1997): Improved Protein Yield (60g/d) w/ Met, Not Lys.
3. Dinn et al. (1998): Milk & Protein on 15.3% CP + RP-Met & Lys = 16.7% CP (< 18.3% CP).



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8. Use “N-Free” AA (MHA; BC-VFA).

# Liquid MHA (Alimet; “N-Free” AA)

1. Koenig et al. (1999): 50% MHA Escaped.
2. Stephenson et al. (1990): Small Wool Growth Response with MHA (20% of Abomasal MHA).
3. Schwab (2003): No Increase in Plasma Met with MHA.

# Same Milk for Less Crude Protein

1. Increase Profits, Reduce Pollution, Better Manure
2. “Safety Margin” Problem.
3. Know How Much Protein is Being Fed.
4. Reduce NPN in Alfalfa Forage (Limited Options).
5. Feed the Bugs Energy to “Mop Up” NPN.
6. How Low Can We go & Maintain Production?